Looking Back and Looking Ahead

Unit Review

In the problems of this unit, you explored many examples of *linear relationships* between variables. You learned how to recognize linear patterns in *graphs* and in *tables* of numerical data and how to express those patterns in words and in symbolic *equations* or *formulas*. Most importantly, you learned how to study tables, graphs, and equations to answer questions about linear relationships.

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Use Your Understanding: Algebraic Reasoning

Test your understanding of linear relationships by solving the following problems about the operation of a movie theater.

1. Suppose that a theater charges a school group $4.50 per student to show a special film. Suppose that the theater's operating expenses include $130 for the staff and a film rental fee of $1.25 per student.

a. What equation relates the number of students x to the theater's income I?

b. What equation relates the theater's operating expenses E to x?

c. Copy and complete the table below.

Theater Income and Expenses

Number of Students, x	0	10	20	30	40	50	60	70
Income, I ($)								
Expenses, E ($)								

d. On the same set of axes, graph the theater's income and operating expenses for any number of students from 0 to 100.

e. Describe the patterns by which income and operating increase as the number of students increases.

f. Write and solve an equation whose solution will answer the question "How many students need to attend the movie so that the theater's income will equal its operating expenses?"

2. At another theater, the income and expenses combine to give the equation $y = 3x - 115$ relating operating profit y to the number of students in a group x.

a. What do the numbers 3 and -115 tell about

i. the relation between the number of students in a group and the theater's profit?

ii. the pattern of entries that would appear in a table of sample (*students, profit*) pairs?

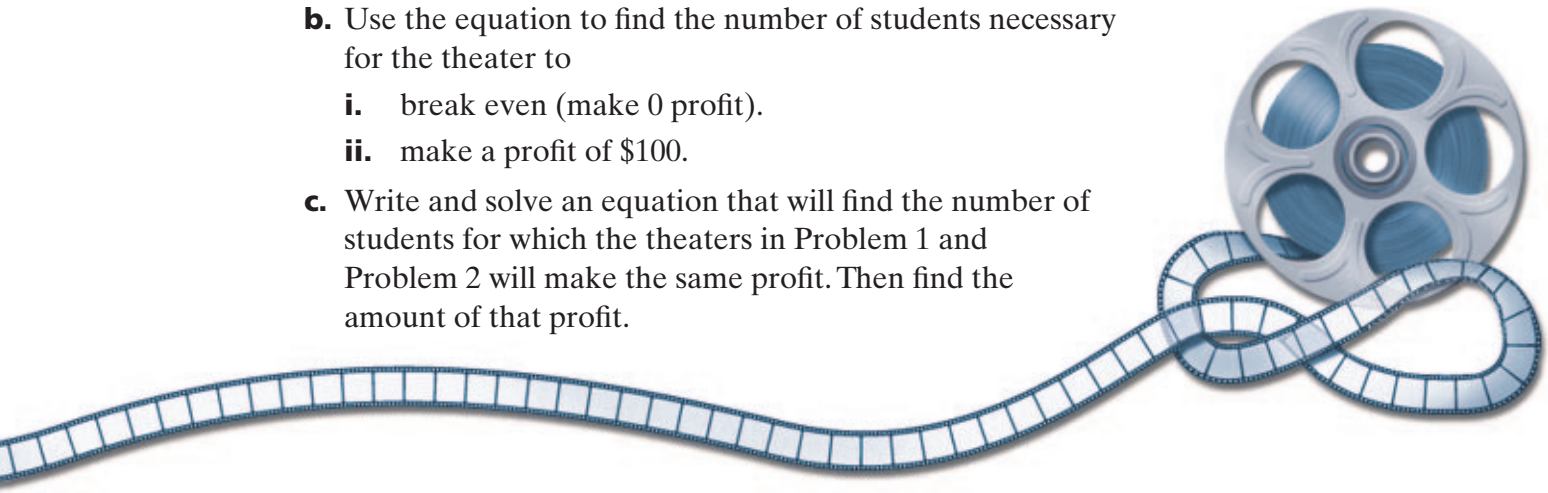
iii. a graph of the relation between the number of students and the profit?

b. Use the equation to find the number of students necessary for the theater to

i. break even (make 0 profit).

ii. make a profit of \$100.

c. Write and solve an equation that will find the number of students for which the theaters in Problem 1 and Problem 2 will make the same profit. Then find the amount of that profit.



Explain Your Reasoning

When you use mathematical calculations to solve a problem or make a decision, it is important to be able to justify each step in your reasoning. For Problems 1 and 2:

3. Consider the variables and relationships.

a. What are the variables?

b. Which pairs of variables are related to each other?

c. In each pair of related variables, how does change in the value of one variable cause change in the value of the other?

4. Which relationships are linear and which are not? What patterns in the tables, graphs, and symbolic equations support your conclusions?

5. For those relationships that are linear, what do the slopes and intercepts of the graphs indicate about the relationships involved?
6. How do the slopes and intercepts relate to data patterns in the various tables of values?
7. Consider the strategies for solving linear equations such as those in Problem 1, part (f), and Problem 2, part (c).
   a. How can the equations be solved using tables of values?
   b. How can you solve those equations by using graphs?
   c. How can you solve the equations by reasoning about the equations alone?
8. Suppose you were asked to write a report describing the relationships among number of students, theater income, and operating costs. What value might be gained by including the table? Including the graph? Including the equation? What are the limitations of each type of display?

Look Ahead

Examples of linear relationships and equations arise in many situations, but there are also important nonlinear relationships such as inverse, exponential, and quadratic. The algebraic ideas and techniques you've used in this unit are useful in problems of science and business. They will be applied and extended to other relationships in future units of Connected Mathematics such as *Thinking With Mathematical Models* and *Say It With Symbols*.